CLAIMS

1. A single lens element used for converting a divergent pencil of rays, radiated from a light source, into a predetermined convergent state, wherein

the single lens element is made from a resin and has a positive optical power due to a refraction effect and a positive optical power due to a diffraction effect,

the diffraction effect is based on a diffraction structure formed on at least one of an incident side surface and an exit side surface of the single lens element, and

following expressions are satisfied:

$$0.1 < NA < 0.3$$

$$0.4 < T/f < 0.75$$

$$2.2 < fr/f < 3$$

wherein,

f is a focal length of the entire single lens element,

fr is a focal length due to the refraction effect of the single lens element,

T is a thickness of the single lens element on an optical axis, and

NA is a numerical aperture of a single lens element at an incident side.

2. The single lens element according to claim 1, wherein a following expression is satisfied:

$$0.8 < t/T < 0.97$$

wherein,

t is a thickness of the single lens element at a thinnest section of a surface having a curvature, when measuring a thickness of the single lens element in a direction parallel to an optical axis.

3. The single lens element according to claim 2, wherein a following expression is satisfied:

$$0.85 < t/T < 0.95.$$

4. The single lens element according to claim 1, wherein a following expression is satisfied:

$$0.5 < T/f < 0.67.$$

5. The single lens element according to claim 1, wherein a following expression is satisfied:

$$5\ \text{mm} \leqq f \leqq 20\ \text{mm}.$$

6. The single lens element according to claim 5, wherein a following expression is satisfied:

$$6\ \text{mm} \leqq f \leqq 10\ \text{mm}.$$

7. The single lens element according to claim 1, wherein the single lens element is a substantially planoconvex shape, and the diffraction structure is formed on a flat surface side.

8. The single lens element according to claim 7, wherein a following expression is satisfied:

$$5.5\ \text{mm} \leqq f \leqq 6.5\ \text{mm}.$$

9. The single lens element according to claim 7, wherein a following expression is satisfied:

$$4\ \text{mm} < T < 4.5\ \text{mm}.$$

10. The single lens element according to claim 7, wherein a following expression is satisfied:

$$10\ \text{mm} < fr < 15\ \text{mm}.$$

11. The single lens element according to claim 7, wherein a following expression is satisfied:

$$0.93 < t/T < 0.97.$$

12. The single lens according to claim 1, wherein the refraction effect is based on an aspheric shape of both the incident side surface and the exit side surface of the single lens element.

13. The single lens element according to claim 12, wherein a following expression is satisfied:

$$8.5 \text{ mm} < f < 9.5 \text{ mm}.$$

14. The single lens element according to claim 12, wherein a following expression is satisfied:

$$4.5 \text{ mm} < T < 5.5 \text{ mm}.$$

15. The single lens element according to claim 12, wherein a following expression is satisfied:

$$14 \text{ mm} < fr < 18 \text{ mm}.$$

16. The single lens element according to claim 12, wherein a following expression is satisfied:

$$0.85 < t/T < 0.92.$$

17. The single lens according to claim 1, wherein the diffraction structure is formed on both the incident side surface and the exit side surface of the single lens element.

18. A light source device for emitting a bundle of rays having a predetermined convergent state, comprising:

a semiconductor laser element which radiates a divergent bundle of rays, and has a characteristic of shifting toward a direction in which a wavelength of the radiated bundle of rays

in accordance with rise in an environmental temperature;

the single lens element according to any of claims 1 to 17 for converting the divergent bundle of rays radiated from the semiconductor laser element, into a predetermined convergent state; and

holding means for integrally holding the semiconductor laser element and the single lens element.

19. The light source device according to claim 18, wherein the semiconductor laser element radiates a bundle of rays whose wavelength $\lambda$ is within either of following ranges:

$$775 \text{ nm} < \lambda < 810 \text{ nm}$$

$$640 \text{ nm} < \lambda < 680 \text{ nm}.$$

20. The light source device according to claim 18, comprising the holding means for integrally holding the semiconductor laser element and the single lens element, wherein heat generated by the semiconductor laser element is transmitted to the single lens element via the holding means.

21. A scanning optical device for imaging and scanning a bundle of rays on a surface to be scanned as a spot, comprising:

a light source device for emitting a bundle of rays having a predetermined convergent state;

an optical deflector for main scanning by reflecting and

deflecting the bundle of rays emitted from the light source device on a deflection surface;

a first imaging optical system for imaging the bundle of rays emitted from the light source device into a linear image extending in a main scanning direction in the neighborhood of the deflection surface of the optical deflector; and

a second imaging optical system comprising a scanning lens for re-imaging the bundle of rays imaged by the first imaging optical system on the surface to be scanned as a spot,

wherein the light source device comprises:

a semiconductor laser element which radiates a divergent bundle of rays, and has a characteristic of shifting toward a direction in which a wavelength of the radiated bundle of rays in accordance with rise in an environmental temperature;

the single lens element according to any of claims 1 to 17 for converting the divergent bundle of rays radiated from the semiconductor laser element, into a predetermined convergent state; and

holding means for integrally holding the semiconductor laser element and the single lens element.

22. The scanning optical device according to claim 21, wherein the light source device comprises temperature transmission means for reducing a temperature difference between the semiconductor laser element and the single lens element.

23. The scanning optical device according to claim 21, wherein the semiconductor laser element and the single lens element are fixed on a common member, and heat generated by the semiconductor laser element is transmitted to the single lens element via the common member.

24. The scanning optical device according to claim 21, wherein the semiconductor laser element comprises heat radiating means.